

Claims

1 1. Apparatus for electroplating a workpiece, comprising:

2  
3 an anode, and a cathode for supporting the workpiece,  
4 wherein the anode and cathode are immersed in a solution,  
5 for generating an electric field emanating from the anode  
6 towards the cathode, to generate a corresponding current to  
7 deposit an electroplating material on the workpiece during  
8 an electroplating process; and

9  
10 a selective anode shield/material flow assembly located  
11 between the anode and the cathode, and forming a multitude  
12 of adjustable openings, the openings having sizes that are  
13 adjustable during the electroplating process for selectively  
14 and controllably adjusting the amount of electric flux  
15 passing through the shield/material flow assembly and the  
16 distribution of the electroplating material across the  
17 workpiece.

1 2. Apparatus according to Claim 1, further comprising a  
2 control connected to the selective shield/material flow  
3 assembly for adjusting the sizes of the openings of the  
4 shield/material flow assembly during the electroplating  
5 process.

1 3. Apparatus according to Claim 1 wherein said selective  
2 shield/material flow assembly includes at least one

3 selective shield material flow mechanism forming a first  
4 series of openings.

1 4. Apparatus according to Claim 1, wherein:

2  
3 the selective shield/material flow assembly includes

4  
5 a first shield/material flow mechanism forming a first  
6 series of openings, and

7  
8 a second shield/material flow mechanism forming a second  
9 series of openings; and

10  
11 the first and second series of openings form the adjustable  
12 openings of the selective shield/material flow assembly.

1 5. Apparatus according to Claim 4, further including: means  
2 connecting the first and second selective shield material  
3 flow mechanisms together for movement relative to each  
4 other, and wherein said first and second selective shield  
5 material flow mechanisms are moved relative to each other to  
6 change the sizes and locations of the adjustable openings of  
7 the selective shield material flow mechanism.

1 6. Apparatus according to Claim 4, wherein said movement  
2 relative to each other is rotational movement.  
3

1       7. Apparatus according to Claim 4, wherein:

2  
3       the first selective shield/material flow mechanism includes

4  
5       a first support member, and

6  
7       a first set of slats supported by the first support member,  
8       and positioned so as to form the first series of openings;  
9       and

10  
11       the second selective shield/material flow mechanism includes

12  
13       a second support member, and

14  
15       a second set of slats supported by the second support  
16       member, and positioned so as to form the second series of  
17       openings.

1       8. Apparatus according to Claim 7, wherein the means  
2       connecting the first and second selective shield/material  
3       flow mechanisms together include a series of links  
4       connecting the first and second support members together for  
5       limited transverse movement relative to each other.

1       9. Apparatus according to Claim 1, further comprising a  
2       support supporting the selective shield/material flow  
3       mechanisms for movement toward and away from at least one of  
4       the anode and the cathode.

1 10. Apparatus according to Claim 9, wherein the support  
2 supports the selective shield/material flow mechanism for  
3 movement along three mutually orthogonal axes, relative to  
4 both the anode and the cathode.

1 11. A method of electroplating a workpiece, comprising  
2 the steps:

3  
4 immersing an anode and a cathode in a solution;

5  
6 using the cathode to support the workpiece;

7  
8 positioning a selective shield/material flow assembly  
9 between the anode and the cathode, said shield/material  
10 flow assembly forming a multitude of openings having  
11 adjustable sizes;

12  
13 generating an electric field emanating from the anode to  
14 the cathode, to generate a corresponding current to  
15 deposit an electroplating material on the workpiece  
16 during an electroplating process;

17  
18 adjusting the sizes of the adjustable openings, during  
19 the electroplating process, for selectively and  
20 controllably adjusting the amount of electric flux  
21 passing through the selective shield/material flow  
22 assembly and the distribution of the electroplating  
23 material across the workpiece.

1 12. A method according to Claim 11, wherein the selective  
2 shield/material flow assembly includes first and second  
3 selective shield/material flow mechanisms, and the  
4 adjusting step includes the step of moving the first and  
5 second selective shield/material flow mechanisms relative  
6 to each other to adjust the sizes of the opening of the  
7 selective shield/material flow assembly.

1 13. A method according to Claim 12, wherein the step of  
2 moving the first and second selective shield/material  
3 flow mechanisms also adjusts the location of the opening  
4 of the selective shield/material flow shield assembly.

1 14. A method according to Claim 12, wherein the first  
2 selective shield/material flow mechanism includes a first  
3 series of through openings, and the second selective  
4 shield/material flow mechanism includes a second series  
5 of through openings, and wherein:

6  
7 the adjusting step further includes the step of using the  
8 first and scend series of openings, in combination, to  
9 form the openings of the selective shield/material flow  
10 assembly; and

11  
12 the moving step includes the step of moving the first and  
13 second selective shield/material flow mechanisms  
14 laterally relative to each other to adjust the sizes of  
15 the openings of the selective shield/material flow  
16 assembly.

1 15. A method according to Claim 12, wherein the  
2 positioning step includes the step of connecting the  
3 first and second selective shield/material flow  
4 mechanisms together for limited movement relative to each  
other.

1 16. A method according to Claim 15, wherein:

2  
3 the positioning step includes the further step of  
4 providing a control means to move the selective  
5 shield/material flow mechanisms relative to each other;  
6 and

7  
8 the adjusting step includes the step of using the control  
9 means to move the selective shield/material flow  
10 mechanisms relative to each other during the  
11 electroplating/electroless process to adjust the sizes  
12 of the openings of the shield/material flow apparatus  
13 mechanism.

1 17. Apparatus for electroless plating comprising:

2  
3 a work piece;

4  
5 a fixture supporting said work piece, wherein said  
6 fixture supporting said work piece is immersed in an  
7 electroless plating solution, for generating an electric  
8 potential emanating from said electroless plating

9 solution towards said work piece for depositing material  
10 on said work piece;

11  
12 a electroless plating flow source;

13  
14 a selective shield/material flow assembly located between  
15 said electroless plating solution source and said fixture  
16 supporting said work piece, and forming a multitude of  
17 adjustable openings, said openings having sizes that are  
18 adjustable for selectively and controllably adjusting the  
19 amount of electroless solution passing through said  
20 selective shield/material flow assembly and the distribution  
21 of depositing material on said work piece.

1 18. Apparatus for depositing material on a work piece  
2 comprising:

3  
4 a source of depositing material;

5  
6 a transport medium;

7  
8 a work piece holder;

9  
10 at least one work piece supported in said work piece holder  
11 and immersed in said transport medium;

12  
13 a selective shield/material flow assembly also immersed in  
14 said transport medium, located between said source of  
15 depositing material and said work piece holder, said

selective shield/material flow assembly forming at least one adjustable opening, said at least one adjustable opening having a size that is adjustable for selectively and controllably adjusting the amount of said depositing material passing through said selective shield/material flow assembly and the distribution of said depositing material on said at least one work piece.

19. The apparatus according to Claim 18, further comprising a control connected to said selective shield/material flow assembly for adjusting the size of said at least one adjustable opening of said selective shield/material flow assembly.

20. The apparatus according to Claim 19 wherein said at least one adjustable opening of said selective shield/material flow assembly is a multitude of openings having adjustable sizes.

21. The apparatus according to Claim 20 wherein said multitude of openings having adjustable sizes are formed by pivoting flaps.

22. The apparatus according to Claim 1, wherein said selective shield/material flow assembly includes:

a first selective shield/material flow mechanism forming at least one first opening,



6 a second selective shield/material flow mechanism forming at  
7 least one second opening, wherein

8  
9 said first selective shield/material flow mechanism and said  
10 second selective shield/material flow mechanism are capable  
11 of movement relative to each other.

1 23. The apparatus of Claim 22 wherein said movement  
2 relative to each other is rotational movement.

1 24. The apparatus of Claim 23 wherein said rotational  
2 movement is axial rotation.

1 25. The apparatus of Claim 23 wherein said rotational  
2 movement is planar rotation.

1 26. Apparatus according to Claim 22 further including means  
2 connecting said first selective shield/material flow  
3 mechanism and said second selective shield/material flow  
4 mechanism together for movement relative to each other,  
5 wherein said first selective shield/material flow mechanism  
6 and said second selective shield/material flow mechanism are  
7 moved relative to each other to change the sizes and  
8 locations of said at least one first opening and said at  
9 least one second opening.

1 27. Apparatus according to Claim 22, wherein said first  
2 selective shield/material flow mechanism includes a first

3 support member, and a first set of slats supported by said  
4 first support member, and positioned so as to form said at  
5 least one first opening; and,

6  
7 said second selective shield/material flow mechanism  
8 includes a second support member, and a second set of slats  
9 supported by said second support member, and positioned so  
10 as to form said at least one second opening.

1 28. Apparatus according to Claim 26, wherein said means  
2 connecting said first selective shield/material mechanism  
3 and said second selective shield/material flow mechanism  
4 together include a series of links connecting said first and  
5 said second support members together for limited transverse  
6 movement relative to each other.

1 29. Apparatus according to Claim 18 further comprising a  
2 structure supporting said selective shield/material flow  
3 assembly for movement along three mutually orthogonal axes,  
4 relative to both said source of depositing material and said  
5 work piece holder.

1 30. The apparatus of Claim 18 wherein said source of  
2 depositing material is an anode, said work piece holder is a  
3 cathode, and said transport medium is an electroplating  
4 solution, wherein said anode and said cathode are immersed  
5 in said electroplating solution for generating an electric  
6 field emanating from said anode towards said cathode, to

7 generate a corresponding current to deposit an  
8 electroplating material on said work piece during  
9 electroplating.

1 31. The apparatus of Claim 30, wherein said a selective  
2 shield/material flow assembly selectively and controllably  
3 adjusts the amount of electric flux passing through said  
4 selective shield/material flow assembly.

1 32. The apparatus of Claim 18, wherein said source of  
2 depositing material is chosen from the group consisting of  
3 spurgers, nozzles, orifices, and atomizers.

1 33. The apparatus of Claim 18 wherein said source of  
2 depositing material comprises metal ions.

1 34. The apparatus of Claim 33 wherein said metal ions are  
2 selected from the group consisting of gold, copper, silver,  
3 tin, lead, nickel, chromium, iron, aluminum, and cobalt.

1 35. The apparatus of Claim 33 wherein said transport  
2 solution medium is an electroless plating solution.

1 36. The apparatus of Claim 18 wherein said transport medium  
2 is selected from the group consisting of air, plating  
3 solution, solid material suspension, gases, electric fields  
4 and magnetic fields.

1        37. A method of plating a work piece comprising the  
2        steps of:

3        providing a source of depositing material;

4        providing a transport medium;

5        providing at least one work piece in a work piece holder;

6        supporting said at least one work piece in said work  
7        holder;

8        immersing said work piece holder in said transport  
9        medium;

10       positioning a selective shield/material flow assembly  
11       between said work piece holder and said source of  
12       depositing material in said transport medium, said  
13       selective shield/material flow assembly forming at least  
14       one opening having an adjustable size; and

15       adjusting the said adjustable size of said at least one  
16       adjustable opening for selectively and controllably  
17       adjusting the amount of said depositing material passing  
18       through said selective shield/material flow apparatus and  
19       the distribution of said depositing material on said at  
20       least one work piece.

1 38. The method according to Claim 37 wherein said  
2 selective shield/material flow assembly further includes  
3 a first selective shield/material flow mechanism and a  
4 second selective shield/material flow mechanism, and the  
5 adjusting step includes the step of moving said first  
6 shield/material flow mechanism and said second  
7 shield/material flow mechanism relative to each other to  
8 adjust the said adjustable size of said at least one  
9 opening of said selective shield/material flow assembly.